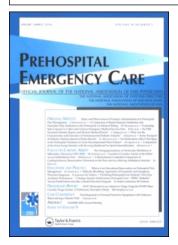
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## PARAMEDIC USE OF THE ENDOTRACHEAL TUBE INTRODUCER IN A DIFFICULT AIRWAY MODEL

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# PARAMEDIC USE OF THE ENDOTRACHEAL TUBE INTRODUCER IN A DIFFICULT AIRWAY MODEL

Michael P. Phelan, MD, JD, Ronald Moscati, MD, Thomas D'Aprix, MD, Glen Miller, BS

**A**BSTRACT

Objectives. To determine whether advanced life support (ALS)-level prehospital providers can be taught to effectively use the Flex-Guide (FG) Endotracheal Tube (ETT) introducer in a difficult airway model by comparing success of styleted ETT intubation with Flex-Guide-assisted intubation. Methods. Intermediate and advanced providers, who brought patients to a Level 1 emergency department, were given a handout and viewed an instructional video describing the bougie and its use. A difficult airway was simulated using the CPR 5000 model mannequin from Medical Plastics Laboratory, Inc. The tongue was inflated to a pressure of 180 mm Hg to partially obscure the view of the airway and a cervical collar was placed to limit flexion and extension. Participants were then asked to intubate the mannequin using both the ETT with a stylet and the bougie-assisted method. Whether the providers used the FG or stylet method first was randomized. Success or failure was recorded and the McNemar test was used to evaluate the paired nonparametric data. Results. A total of 96 providers (66% advanced, 34% intermediate) were enrolled, 69 successfully intubated using the FG, while 64 successfully intubated with the stylet. Comparing successful bougie intubations with successful stylet intubations using the McNemar test, no significant difference was found between the groups (p = 0.486). Conclusion. Prehospital care providers were as successful intubating a difficult airway model using the newly learned bougie technique as they were using the more familiar styleted ETT technique. Key words: prehospital care; endotracheal tube introducer; bougie; difficult airway.

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Airway management is the first priority in any resuscitation. In cases where invasive airway control is indicated, it is most commonly achieved by placement of an endotracheal tube (ETT) with the aid of a stylet using direct laryngoscopy. When prehospital care providers are unable to secure the airway by this

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method, they have limited alternatives for airway control, i.e., the esophageal obturator airway (EOA), needle cricothyroidotomy, and more recently, the laryngeal mask airway (LMA). The gum elastic bougie (or ETT introducer) could be a valuable and inexpensive addition to this armamentarium.

The bougie (for simplicity, we refer to the gum elastic bougie and all of its variants simply as the bougie) has been found to reduce the incidence of failed intubation. And is widely used in the UK as standard anesthetic equipment. In fact, 100% of respondents to an unpublished survey in the UK use the bougie as their first choice when faced with a unexpected difficult intubation. Using the bougie instead of a stylet requires, on average, only seconds longer to perform intubation. Currently, the bougie has been reported to be in limited use by emergency physicians, thus its use increases in emergency departments (EDs), the next logical extension is to the prehospital setting.

This study attempted to assess the ability of prehospital providers to quickly learn to use the bougie in the case of a difficult airway. We hypothesized that medics would be at least as successful with the bougie as they were with a styleted ET on a difficult airway model.

#### **METHODS**

# Design

We conducted a prospective, non-blinded, paired study of prehospital care providers' ability to successfully intubate a difficult-airway mannequin using traditional laryngoscope and stylet versus laryngoscope and bougie. Intermediate and Advanced providers from both volunteer and commercial companies were enrolled. The bougie variant used for this study was Flex-Guide Endotracheal Tube introducer (GreenField Medica Sourcing, Inc., Northbourough, MA). The difficult airway was simulated using a CPR 5000 model mannequin from Medical Plastics Laboratory Inc. (Gatesville, TX). This mannequin has an inflatable tongue that allows for varying obstruction of the upper airway. A manometer was used to ensure that the inflation pressure of the tongue remained constant for each intubation attempt. The degree of obstruction that we felt represented a difficult airway was determined by inflating the tongue such that four emergency medicine attending staff had difficulty visualizing the vocal cords; Mallampati Grade 4. The

average manometer pressure for this level of obstruction was found to be 180 mm Hg. To further simulate a difficult airway, the mannequin was fitted with a standard cervical collar to limit neck movement. The anterior neck of the mannequin has a visualization window in its midline that allows easy assessment of ETT placement. Data collectors observed medics performing the intubations and determined their success or not by looking for the endotracheal tube in the tracheal window on the mannequin's neck and then entered the result on the data collection sheet.

### **Population**

Intermediate and advanced providers transporting patients to the ED at Erie County Medical Center were asked to participate. After obtaining informed consent, the participants were given a handout and viewed a brief (three minute) instructional video describing the bougie and its use. These providers were allowed to practice using the bougie with a regular airway mannequin. Participants were then asked to intubate the difficult airway model using both an ETT with a stylet and an ETT over the bougie. Providers were randomized to use the bougie or stylet method first using a randomization scheme from True EpiStat (EpiStat Services, Richardson, TX).

### **Human Subject Review**

This study was reviewed and approved as an exempt study by the Institutional Review Board for the State University of New York at Buffalo School of Medicine.

#### Sample Size

Prior studies estimate that the rate of successful placement of ETTs by paramedics is anywhere from 75%<sup>5</sup> to 90%.<sup>6</sup> Presumably, the success rate of intubations would be lower in a difficult airway model, so for the study we estimated a success rate of approximately 60% using a styleted ETT. We felt a 20% difference in success rates would be clinically significant. Based upon this difference and a statistical significance threshold of 0.05, the study would have a power of 0.80 with a sample size of 81 paired intubations.

#### RESULTS

Of the enrolled 96 providers (66% advanced, 34% intermediate), 69 successfully intubated using the bougie, while 64 successfully intubated with the stylet. The average years as a provider was 4.1 years and ranged from 0-23 years. Fifty providers were able to successfully intubate using either method and 13 were unable to intubate this model using either technique. Nineteen providers were able to intubate this model with the bougie but failed to do so with the stylet. Conversely, 14 providers were successful with the

stylet but failed with the bougie. Comparing successful bougie intubations with successful stylet intubations using the McNemar test, no significant difference was found between the groups (p = 0.486).

# **DISCUSSION**

Macintosh first described using the gum elastic bougie in 1949 in a variety of difficult to intubate situations, particularly incomplete larynx visualization. Medics and residents are taught to place an ETT only when the cords are clearly visualized. However, cord visualization can be difficult because of variations in anatomy, presence of blood, patient position, etc. At times, only the epiglottis can be seen, and sometimes this isn't even the case. Such a situation is ideal for the bougie because it can be placed into the trachea despite a lack of visualization of the cords. 3.4

Our data demonstrate that 72% (69/96) of participants successfully used the bougie, while 67% (64/96) were successful with the styleted ETT (no statistically significant difference). We expected the difficult airway model to be challenging, and the success rates obtained were below those reported for successful intubations by paramedics.<sup>85,6</sup> While not simulating every type of difficult airway, this did confirm that the mannequin is indeed a "difficult airway" model.

The results also demonstrate that medics were equally successful with both techniques. The fact that the medics had just been introduced to the bougie and briefly taught how to use it by videotape makes the outcome intriguing. Experienced medics would be expected to do better with a technique they are familiar and comfortable using. However, the bougie is so easy to learn to use and so effective as a difficult airway adjunct that they did just as well with the new technique. With experience using the bougie, one might expect the difficult airway success rates to increase.

A true inservice using actual instructors, regular and difficult airway mannequins under observation, and even supervised initial experience with the bougie in non-difficult human airways would be a more complete method to teach the use of the bougie. As compared with static learning watching a three-minute videotape, one would expect greater initial competence with proper training.

Other studies have shown that the bougie works well as an airway adjunct for the difficult airway in the operating room and ED settings. In the prehospital setting, medics have limited options available to them in the case of a failed intubation attempt. The addition of a simple, safe, and inexpensive alternative technique such as the bougie could prove quite useful in such cases.

In one other study using mannequins in a headneutral position, researchers evaluated the use of the ETT introducer and obtained results similar to ours.<sup>8</sup> The addition of a mannequin whose tongue could be inflated as well as his head maintained in a neutral position added an additional dimension to our difficult airway mannequin. Despite this increased difficulty, the participants were equally successful with the sytleted intubation and the ETT intubations. It suggests that the successful rate with additional training experience would be better than those.

#### LIMITATIONS

There are limitations to this study. Medics were not routinely observed directly by physicians during their intubation attempts, but were observed by trained data collectors. While data collectors observed the medics perform intubations and ensured the protocol was followed, the data collectors were not emergency medicine physicians trained in advanced airway techniques. Intubating a difficult airway mannequin obviously cannot reproduce all the potential clinical situations that a real difficult airway situation presents. The model did not exactly replicate the real life situation that medics may face, however as an approximation it was adequate. The results may have been different in a real clinical setting.

The model was not an ideal example of the difficult airway. A number of factors, like the presence of foreign material, airway injury, patient anatomy and position, and the crisis environment, combine to make an airway a difficult one to intubate. This is difficult to duplicate for the purposes of conducting research. Our model mannequin had an inflatable tongue obscuring the view of the cords when attempting to view them with a laryngoscope. While this may not simulate

every type of difficult airway, it does model the most important issue, which is lack of visualization.

#### **C**ONCLUSION

Our study shows that prehospital providers, experienced in traditional intubation techniques, can intubate equally successfully in a difficult airway model using the bougie technique with minimal training and no prior experience. It suggests that success rates with additional training and experience would be better than those with traditional techniques. Additional studies using the bougie in the prehospital setting are warranted.

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